IB IL DALI/PWR-PAC

**Inline, DALI master,
integrated DALI power supply unit,
safe electrical isolation**

Data Sheet
7607_en_01

1 Description

The IB IL DALI/PWR-PAC terminal is designed for use within an Inline station.

It is a DALI master and is used to control lights with DALI ballasts according to IEC 60929. As defined in the DALI standard, up to 64 ballasts can be addressed individually.

The terminal requires a 24 V DC supply for the integrated DALI bus supply. This can be provided via the potential jumper U_M or supplied via connector 1.

Features

- DALI master with integrated DALI bus supply
- Designed for single master operation
- Safe electrical isolation of the DALI bus
- DALI bus protected against accidental connection of the mains voltage (up to 250 V AC)
- Can be extended by up to three IB IL DALI-PAC terminals
- Communication via process data
- Indicators for diagnostics, transmission, and reception

	This data sheet is only valid in association with the IL SYS INST UM E user manual.
	Make sure you always use the latest documentation. It can be downloaded at phoenixcontact.net/product/2897813.
	This document is valid for all products listed in the “Ordering data” on page 3

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2 Ordering data

Product

Description	Type	Order No.	Pcs./Pck.
Inline, DALI master, integrated DALI power supply unit, safe electrical isolation, transmission speed in the local bus: 500 kbps, degree of protection: IP20, including Inline connectors and marking fields	IB IL DALI/PWR-PAC	2897813	1

Accessories	Type	Order No.	Pcs./Pkt.
Labeling field, width: 12.2 mm (Marking)	IB IL FIELD 2	2727501	10
Labeling field, width: 48.8 mm (Marking)	IB IL FIELD 8	2727515	10
Insert strip, Sheet, white, unlabeled, can be labeled with: Office printing systems: Laser printer, mounting type: insert, lettering field size: 62 x 10 mm (Marking)	ESL 62X10	0809492	1
Insert strip, Sheet, white, unlabeled, can be labeled with: Office printing systems: Laser printer, mounting type: insert, lettering field size: 62 x 46 mm (Marking)	ESL 62X46	0809502	5

Optional accessories

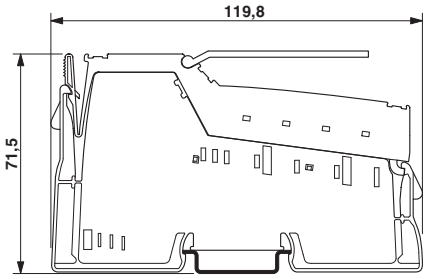
Description	Type	Order No.	Pcs./Pck.
Inline, DALI master, Extension for IB IL DALI/PWR-PAC, transmission speed in the local bus: 500 kbps, degree of protection: IP20, including Inline connector and labeling field	IB IL DALI-PAC	2897910	1

Documentation

Description	Type	Order No.	Pcs./Pck.
User manual: "Automation Terminals of the Inline Product Range"	IL SYS INST UM E	2698737	1
DALI documentation	See www.dali-ag.org		

3 Technical data

Dimensions (nominal sizes in mm)	



Width	48.8 mm
Height	119.8 mm
Depth	71.5 mm
Note on dimensions	Housing dimensions

General data	
Weight	235 g (complete with connectors and end terminal); 194 g (with connectors, without end terminal)
Operating mode	Process data mode with 2 words
Ambient temperature (operation)	-25°C ... 60°C (Observe derating when using DALI extension terminals.)
Ambient temperature (storage/transport)	-25°C ... 85°C
Permissible humidity (operation)	10 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	10 % ... 95 % (non-condensing)
Permissible air pressure (operation)	80 kPa ... 106 kPa (up to 2000 m above sea level)
Permissible air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Protection class	III, IEC 61140, EN 61140, VDE 0140-1

Connection data: Inline connector	
Connection method	Spring-cage connection
Conductor cross section solid / stranded	0.2 mm² ... 1.5 mm² / 0.2 mm² ... 1.5 mm²
Conductor cross section [AWG]	24 ... 16
Stripping length	8 mm

Interface: Inline local bus	
Connection method	Inline data jumper
Transmission speed	500 kbps

Interface: DALI	
Connection method	Inline connector
Supply voltage	typ. 14 V DC (Bus voltage)
Output current with short-circuit	max. 250 mA
Current carrying capacity	max. 128 mA (Bus load, Observe derating when using DALI extension terminals.)
Transmission speed	1200 bps
Bus protected up to 250 V AC, maximum	yes

System limits	
Number of local bus devices that can be connected	3 (DALI extension terminals IB IL DALI-PAC, Order No. 2897910)

Communications power (U_L)	
Supply voltage	7.5 V DC
Current draw	max. 38 mA

Main circuit supply (U_M)	
Supply voltage	24 V DC (via voltage jumper)
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current draw	max. 441 mA $I_M \approx 0.86 * \Sigma I_{DALI}$ Where: ΣI_{DALI}:Total DALI bus load including all DALI extension terminals

Power dissipation	
Maximum power dissipation for nominal condition	10.6 W

Formula to calculate the power dissipation in the terminal

$P_{TOT} = P_{BUS} + P_{DRV} + P_{SUPPLY}$

$P_{BUS} = 0.27\ W$

$P_{DRVmax} = 0.56\ W + I_{DALI1} \times (I_{DALI1} \times 3.85\ \Omega + 0.47\ V)$

$P_{DRV\_ICS} = 0.37\ W + I_{DALI1} \times (I_{DALI1} \times 4.7\ \Omega + 0.58\ V)$

$P_{SUPPLY} = \Sigma\ I_{DALI} \times 3.6\ V$

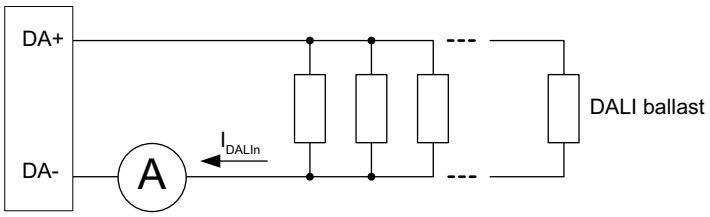
$\Sigma\ I_{DALI} = I_{DALI1} + I_{DALI2} + I_{DALI3} + I_{DALI4}$

$\Sigma\ I_{DALI} \approx N \times 2\ mA$

Where:

P_{TOT}	Total power dissipation in the terminal
P_{BUS}	Power dissipation through bus operation
P_{DRV}	Power dissipation through the DALI bus driver, depends on the bus load and activity on the DALI bus (idle, transmitting, receiving)
P_{DRV_ICS}	Typical power dissipation through the DALI bus driver when operating the DALI terminal on bus controllers from the Inline Control Server (ICS) range
P_{SUPPLY}	Power dissipation through the DALI power supply
I_{DALIn}	DALI bus load of the individual terminals
I_{DALI1}	DALI bus load at the IB IL DALI/PWR-PAC terminal
$\Sigma\ I_{DALI}$	Load of the DALI supply including all extension terminals
N	Total number of all IB IL DALI/PWR-PAC terminals and their ballasts supplied by up to three extension terminals $0 \le N \le 256$

The above approximation of the DALI bus load $\Sigma\ I_{DALI}$ is based on the maximum value of 2 mA per ballast as defined in the standard. For precise values, use the manufacturer's information for the ballasts or take your own measurements.



The total load is the sum of all measured currents I_{DALIn} at the IB IL DALI/PWR-PAC terminal and all IB IL DALI-PAC extension terminals that are connected to it.

Derating, limitation of simultaneity			
Permissible total current $\Sigma\ I_{DALI}$ depending on the ambient temperature T_{amb}			
T_{amb}	**$\Sigma\ I_{DALI}$**	**Number of DALI buses**	**Number of DALI devices (2 mA) per bus**
Up to 40°C	≤ 512 mA	4	64
Up to 45°C	≤ 512 mA	4	64
Up to 50°C	≤ 400 mA	3	64
Up to 55°C	≤ 330 mA	3	55
Up to 60°C	≤ 140 mA	2	35

Safety equipment	
Surge voltage on DALI bus	275 V varistor
Short circuit on DALI bus	Electronic fuse, no time limit

Programming data (INTERBUS, local bus)	
ID code (hex)	BF
ID code (dec.)	191
Length code (hex)	02
Length code (dec.)	02
Process data channel	32 Bit
Input address area	4 Byte
Output address area	4 Byte
Parameter channel (PCP)	0 Byte
Register length (bus)	32 Bit

For the programming data/configuration data of other bus systems, please refer to the corresponding electronic device data sheet (e.g., GSD, EDS).

Configuration and parameter data in a PROFIBUS system	
Required parameter data	1 Byte
Required configuration data	5 Byte

Electrical isolation

Common Potentials

24 V main voltage U_M and GND have the same potential. FE is a separate potential area.

Separate Potentials in the IB IL DALI/PWR-PAC Terminal

Test distance	Test voltage
7.5 V supply (bus logic)/24 V supply (I/O) and FE	500 V AC, 50 Hz, 1 min.
7.5 V supply (bus logic)/DALI bus Routine test	2500 V AC, 50 Hz, 1 min. 1200 V AC, 50 Hz, 1 min.
24 V supply (I/O) and FE/DALI bus Routine test	2500 V AC, 50 Hz, 1 min. 1200 V AC, 50 Hz, 1 min.

Error messages to the higher-level control or computer system

I/O error message in the event of DALI bus voltage failure or short circuit of the DALI bus

Approvals

For the latest approvals, please visit phoenixcontact.net/products.

4 Internal basic circuit diagram

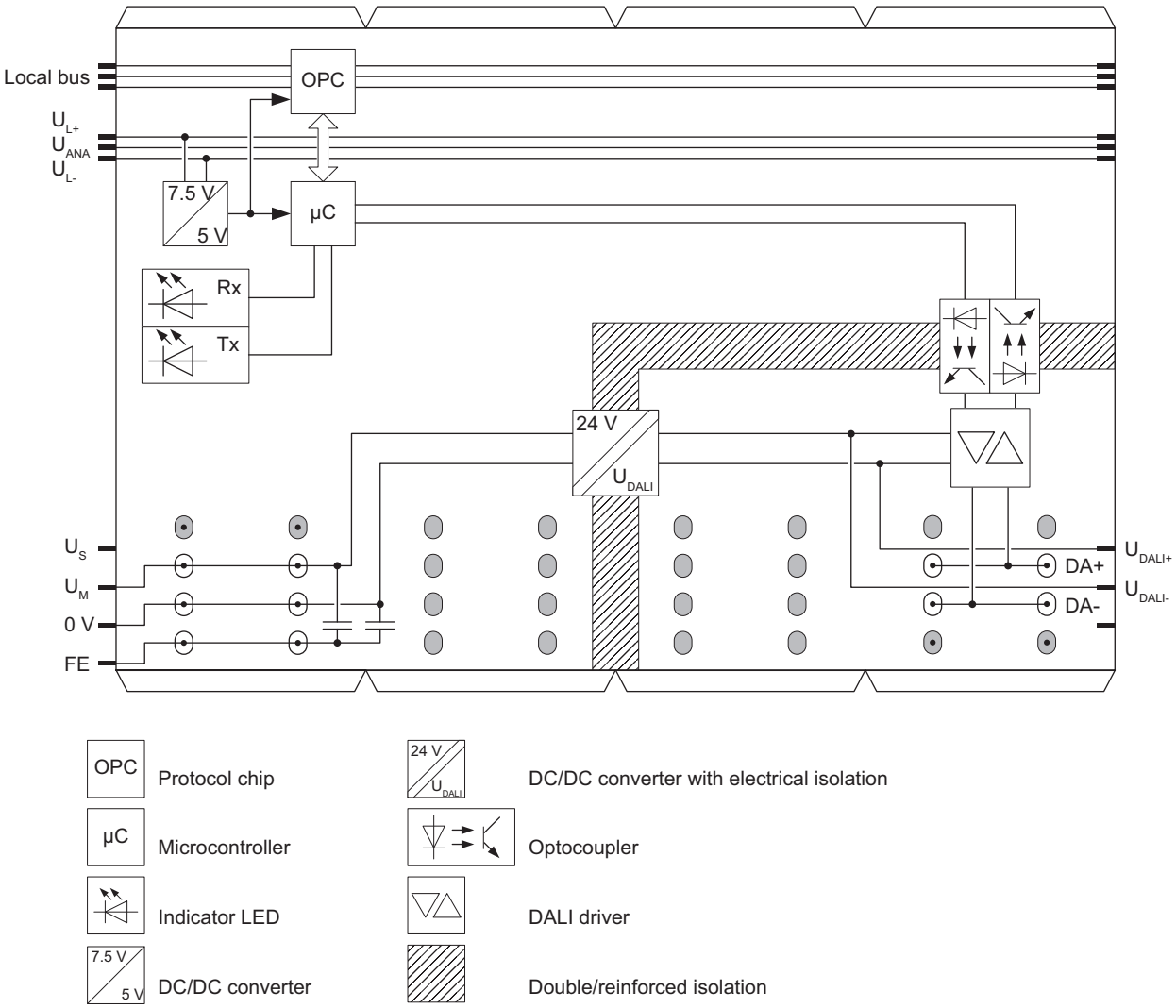


Figure 1 Internal basic circuit diagram

Other symbols used are explained in the IL SYS INST UM E user manual.

5 Local diagnostic and status indicators

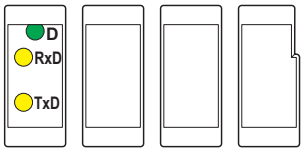


Figure 2 Local diagnostic and status indicators

Des.	Color	Meaning
D	Green	Diagnostics
RxD	Yellow	Terminal is receiving data from the DALI bus
TxD	Yellow	Terminal is transmitting data to the DALI bus

Function identification

Orange

6 Terminal point assignment

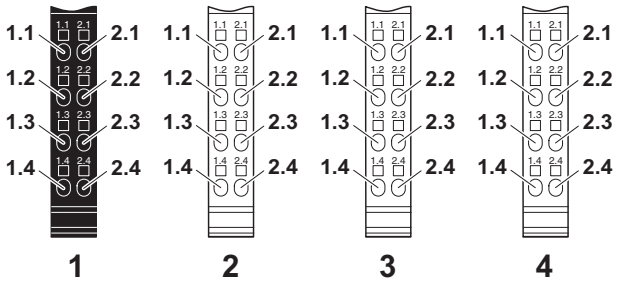


Figure 3 Terminal point assignment

Connector	Terminal point	Signal	Assignment
1	**1.1, 2.1**	**–**	Not used
	1.2, 2.2	**U_M**	+24 V supply voltage, internally connected to the potential jumper U_M
	1.3, 2.3	**GND**	24 V supply voltage ground
	1.4, 2.4	**FE**	Functional earth ground, internally connected to the potential jumper FE
2	Not used		
3	Not used		
4	**1.1, 2.1**	**–**	Not used
	1.2, 2.2	**DA+**	DALI bus (positive)
	1.3, 2.3	**DA-**	DALI bus (negative)
	1.4, 2.4	**–**	Not used

Terminal points not used by the terminal must not be wired.

Terminal points 1.2, 1.3, 2.2, and 2.3 of connector 1 are connected internally with a capacitor to FE (see Figure 1).

The DALI bus supply must only be provided via the potential jumpers U_M on the side **or** via connector 1.

For example, if the IB IL DALI/PWR-PAC terminal is directly preceded by a 24 V segment, the supply is already provided via the potential jumpers. Supply via connector 1 is then **not permitted** (see also "Typical station structure" on page 11).

7 Connection notes

The voltage drop between the transmitter and receiver on the DALI bus cable must not exceed 2 V at 250 mA. The table below contains recommended values for wiring. The maximum cable length between two bus devices should not exceed 300 m.

Cable Length	Minimum Cross-Section
< 100 m	0.5 mm^2
100 m ... 150 m	0.75 mm^2
> 150 m	1.5 mm^2

Special bus cables (twisted or shielded) are not required. Serial and star network topologies or a combination of both can be used. Ring structures should be avoided.

DALI interface insulation in the ballasts of lights only meets the requirements of basic insulation. SELV (safety-extra low voltage) is therefore not ensured on the DALI bus despite the safe isolation of the IB IL DALI/PWR-PAC terminal.

The IB IL DALI/PWR-PAC terminal is not suitable for use if the DALI bus is supplied externally, e.g., by other bus devices. In this case, the IB IL DALI-PAC terminal should be used.

8 Connection example

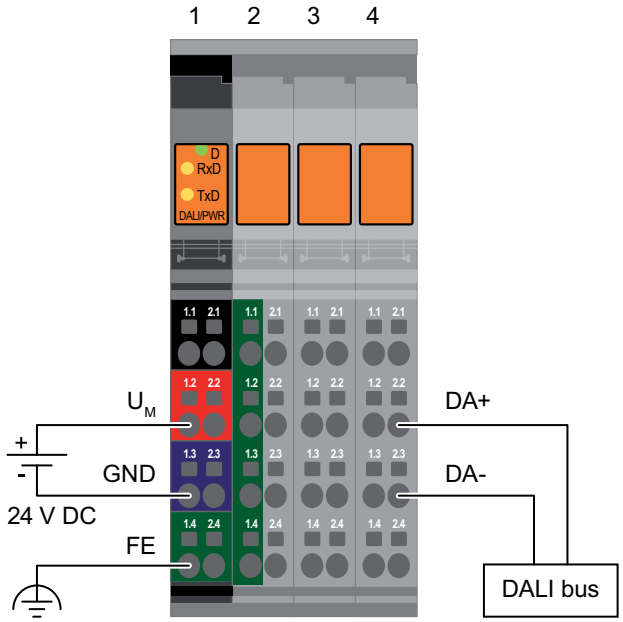


Figure 4 Connection example

The supply must only be provided via the potential jumpers U_M on the side or via connector 1.

For example, if the IB IL DALI/PWR-PAC terminal is directly preceded by a 24 V segment, the supply is already provided via the potential jumpers. Supply via connector 1 is then not permitted.

9 Typical station structure

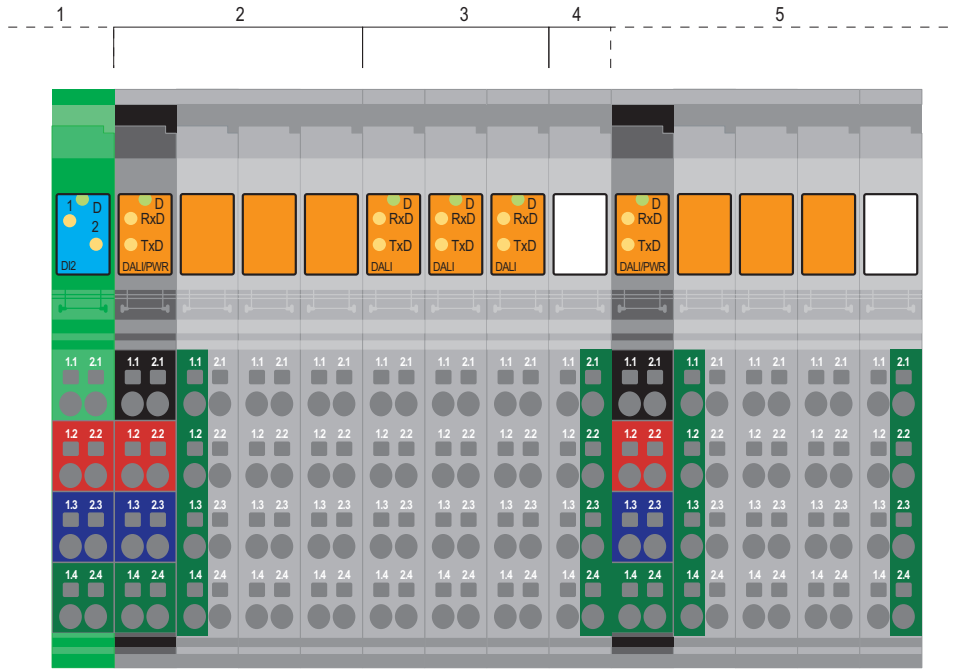


Figure 5 Typical station structure with several DALI terminals

Figure 5 shows a typical station structure when using several DALI terminals. The station consists of the following sections:

1 24 V segment.

2 IB IL DALI/PWR-PAC terminal.
The DALI bus supply is supplied from the preceding 24 V segment via the potential jumpers (U_M) on the side. U_M and GND of connector 1 remain unwired.

3 Up to three IB IL DALI-PAC extension terminals.
The DALI bus supply of these DALI masters is provided by the preceding IB IL DALI/PWR-PAC terminal via the potential jumpers U_{DALI}.

4 Distance terminal as the end terminal for the DALI segment. This distance terminal is supplied as standard with the IB IL DALI/PWR-PAC terminal. It must always be used to ensure correct termination of the DALI segment – regardless of how many DALI extension terminals (0 to 3) are used in this DALI segment.

5 Next DALI segment starting with an IB IL DALI/PWR-PAC terminal, no DALI extension terminals in the example.
As this terminal is not preceded by a 24 V segment (i.e., 24 V DC is not supplied via the potential jumpers U_M), the DALI bus supply must be supplied via connections 1.2 and 1.3 (or 2.2 and 2.3) of connector 1. The required 24 V DC supply can be tapped from section 2, e.g., at connector 1 (connections 1.2 and 1.3 or 2.2 and 2.3) (observe maximum permissible currents). This DALI segment must also be terminated by a distance terminal used as the end terminal.

Every DALI segment must be terminated by the end terminal supplied. Otherwise, under certain circumstances the electrical isolation between U_M/U_S and the DALI bus may be compromised.

The DALI busses in section 2 and 3 in Figure 5 are not electrically isolated from one another. Usually this does not present a problem. However, if such isolation is required, the IB IL DALI/PWR-PAC terminals must not be extended by IB IL DALI-PAC terminals (and used to supply them).

However, the DALI busses in section 2 and 3 are electrically isolated from the DALI bus in section 5, even in the event that all sections are supplied from the same 24 V DC supply (U_M).

10 Process data

10.1 Process data output word OUT1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	TB	Command			0	0	0	0	0	0	0	0

Bits 10 to 8: Command

Bit			Command	Description
10	9	8		
0	0	0	Idle	DALI bus in the idle state
0	0	1	Send	Send DALI command
0	1	0	Repeat	Send DALI command again (50 ms)
0	1	1	Reserved	
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Bit 11: TB (Toggle Bit)

This bit is used when commands with the same command field are to be sent consecutively.

10.2 Process data output word OUT2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Address byte								S = 0: Data byte S = 1: Command byte							
Y	A	A	A	A	A	A	S								

10.3 Process data input word IN1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	K	AW	F	TB	Command			Response							

10.4 Process data input word IN2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Address byte								S = 0: Data byte S = 1: Command byte							
Y	A	A	A	A	A	A	S								

The input words mirror the output words. Possible differences for IN1:

- **SB** indicates an I/O error (DALI supply failure, short circuit on the DALI bus or error in the driver circuitry)
- **K** is set if an unsupported command has been received via INTERBUS (no action on the DALI bus)
- **AW** (response) is set if a valid response has been received from the ballast; only then is the response field to be evaluated (otherwise as for OUT1)
- **F** is set if an invalid response has been received from the ballast (e.g., fault on the DALI bus)

11 Function description

The terminal checks incoming process data words for changes to the command byte (high byte of OUT1). The toggle bit is typically inverted by the application of the INTERBUS master on every new DALI transaction.

In OUT2, the terminal transmits the DALI command to be sent to the DALI bus. The data word in OUT2 is therefore not interpreted in any way by the terminal.

The terminal starts sending OUT2 to the DALI bus if:

– A change in the command byte has been detected
– The command byte contains a valid "Send" or "Repeat" command
– The DALI bus is in the idle state (previous transmission with the DALI bus completed successfully)

The terminal then waits around 10 ms for a response from the DALI slave and receives it, if present.

Finally, the terminal copies process data words OUT 1/2 to process data words IN 1/2 and modifies status bits SB, K, AW, and F as well as the response byte accordingly. This acknowledgment indicates that the terminal is ready for the next command.

If a valid DALI response has been received, the terminal waits around a further 10 ms after receiving the response (DALI bus pause). As acknowledgment, bit AW is then set in process data word IN1, and the response is copied to the low byte of IN1.

The "Repeat" command is used to send the DALI command twice in intervals of 50 ms (start of first transmission - start of second transmission). The command is processed in the same way as the "Send" command. Certain DALI commands have to be sent twice in order to be completed correctly. This can be achieved using the "Repeat" command independently of the bus cycles of the local bus.